Page 17, line 33, change "parent application 08/489,068" to -- Patent No. 5,721,566 --.

Page 18, line 20, change "co-pending patent application 08/489,068" to -- Patent No. 5,721,566 --.

Page 31, line 8, change "copending parent applications 08/534,791" to -- Patent No. 5,739,811--.

Page 31, line 10, change "U.S. patent application Serial No. 08/_____" to -- Patent No. 5,734,373 --.

Page 31, line 18, change "nos. 08/374,288 and" to -- no. --.

Page 31, line 19, change "1/18/95 and 3/3/95, repsectively" to -- 3/3/95, and Patent No. 5,731,804, filed 1/18/95 --.

Page 34, line 27, change "Application Serial No. 08/275,120" to -- No. 5,623,582 --.

Page 35, line 30, change "nos. 08/374,288" to -- no. --.

Page 35, line 31, change "1/18/95 and 3/3/95, respectively; Serial no. 08/489,068" to -- 3/3/95; Patent No. 5,731,804, filed 1/18/95; Patent No. 5,721,566 --.

Page 35, line 33, change "08/_____" to -- 08/560,091 --.

page 49, line 31, change "applications 08/489,068, and Serial no. 08/_____" to -- application Serial No. 08/560,091 --.

Page 49, line 34, after "Computer Systems' ", insert -- and Patent No. 5,721,566, --.

Page 75, line 5, change "patent application _____" to -- Patent No. 5,734,373 --.

In the Claims

All pending claims are reproduced below for the convenience of the Examiner. Claims that have been changed by this amendment are labelled as "amended."

Please cancel claims 1-87 without prejudice.

Please add the following claims:

88. (new) A method for providing force feedback to the user of a graphical user interface displayed by a computer system and for aiding a user in manipulating a user-controlled cursor and in targeting graphical elements in said graphical user interface, said graphical elements interfacing said user to functions of said computer system, the method comprising:

enabling a reception of data representing a displayed location of said user-controlled cursor within said graphical user interface displayed on a display screen of said computer system, a determination of said displayed location based upon signals received from a user interface device that represent the motion of a manipulatable physical object in at least one degree of

freedom, said interface device coupled to said computer system and including an actuator for applying electronically modulated forces to be felt by said user, wherein said forces are modulated as a function of the location of said physical object in said at least one degree of freedom;

enabling a selection of a force sensation to be output to said user based at least in part on said data representing said displayed location, wherein a plurality of targets displayed within said graphical user interface are associated with target force sensations that are output to said user, wherein said targets allow said user to interface with operating system functions implemented by said computer system, and wherein a particular target is associated with at least two different ones of said target force sensations, said force sensations being different such that said actuator changes its force output based on said force sensation to be output, a first one of said different force sensations selected to be output to said user when said cursor is moved from a position outside a boundary of said particular target to a position inside said boundary, a second one of said different force sensations selected to be output to said user when said cursor is moved from a position inside said boundary to a position outside said boundary; and

cont.

enabling a producing of a signal to cause said selected force sensation to be output as forces to said user by said actuator.

89. (new) A method as recited in claim 88 wherein a third one of said different force sensations is selected to be output to said user when said cursor is moved within said particular target inside said boundary.

90. (new) A method as recited in claim 88 wherein said first one of said different force sensations provides an attractive force that assists said user in bringing said cursor into said target boundary.

91. (new) A method as recited in 90 wherein said second one of said different force sensations provides a barrier force that resists motion of said user object in moving said cursor out of said boundary.

92. (new) A method as recited in 88 wherein said force sensations provide different force magnitudes.

93. (new) A method as recited in 88 wherein said third one of said different force sensations is one of a vibration sensation and a texture sensation.

94. (new) A method as recited in 88 wherein said first one of said different force sensations provides an attractive force that assists said user in bringing said cursor upon said target, and wherein said second one of said different force sensations is a barrier force that resists

said user in removing said cursor from said target such that a magnitude of said attractive entry force is different than a magnitude of said resistive exit force.

95. (new) A method as recited in claim 91 wherein said particular target is a menu item in a pull down menu and wherein said barrier force helps said user from overshooting a particular menu selection in said menu item with said cursor.

96. (new) A method as recited in claim 88 wherein a history of sensor readings is used to determine if said cursor is moving into or out of said boundary.

97. (new) A method as recited in claim 88 wherein said second one of said different force sensations is not output as forces by said actuator if said particular target has been selected by said user prior to moving said cursor from inside to outside said boundary.

98. (new) A method as recited in claim 88 wherein said third one of said different force sensations is no longer output as forces by said actuator after said particular target has been selected by said user, provided that said cursor has not exited and re-entered said boundary.

99. (new) A method for providing force feedback to the user of a graphical user interface displayed by a computer system, said user using an interface device including a physical object contacted and moved by said user in a plurality of degrees of freedom, an actuator for imparting an electronically modulated force to said user, and a sensor apparatus for providing a locative signal responsive to and corresponding with manipulation of said object in said degrees of freedom, wherein a displayed cursor has a location correlated to said physical object as indicated by said locative signal, the method comprising:

receiving an indication that said cursor is interacting with at least one graphical object displayed in said graphical user interface;

determining a collision force to be output by said actuator of said interface device, said collision force based on a force sensation associated with said cursor interacting with said at least one graphical object;

scaling a magnitude of said collision force, wherein said scaling is based on a current velocity of said cursor in said graphical user interface, said scaling being performed after said collision force is determined; and

outputting said scaled collision force to said physical object by said actuator of said interface device.

100. (new) A method as recited in claim 99 wherein said cursor is assigned a mass and said mass influences said magnitude that is scaled.

101. (new) A method as recited in claim 99 wherein said force sensation is associated with all graphical objects having a particular type, wherein said at least one graphical object has said particular type.

102. (new) A method as recited in claim 99 wherein said graphical user interface displays graphical objects of a plurality of types, said types including icons, windows, and menu items.

103. (new) A method of creating a tactile user interface performed on a computer system, wherein a user feels force sensations when a graphically displayed cursor interacts with a graphical object associated with a function of said computer system and displayed in a graphical user interface on a display device, and a location of said cursor on said display device is updated based on a received indication of movement of a physical object that is manipulated by said user, said physical object being included in a human interface device that outputs said indication to said computer system, said method comprising:

defining a graphical object as a pass-through object or a solid object;

associating said solid object with a force sensation;

if said cursor has entered a region associated with said solid object, enabling the sending of a signal to said human interface device, said signal representing said force sensation, wherein said human interface device outputs said force sensation to said user using at least one electronically-modulated actuator; and

if said cursor has entered a region associated with said pass-through object, disabling said signal to said human interface device such that said human interface device does not output said force sensation to said user using said at least one electronically-modulated actuator.

104. (new) A method as recited in claim 103 wherein said force sensation is defined by sensation parameters.

105. (new) A method as recited in claim 104 wherein said sensation parameters include a duration parameter that indicates the time duration for which said force sensation should execute.

106. (new) A method as recited in claim 103 wherein said force sensation is a vibration sensation.

107. (new) A method as recited in claim 104 wherein said sensation parameters include magnitude, frequency, and duration parameters.

108. (new) A method as recited in claim 103 wherein said force sensation is a texture sensation.

109. (new) A method as recited in claim 103 wherein said graphical object is an icon.

110. (new) A method as recited in claim 103 wherein said graphical object is a menu item.

111. (new) A method as recited in claim 103 wherein said graphical object is a hyperlink on a web page.

112. (new) A method as recited in claim 103 wherein said signal is a high-level command including said sensation parameters.

113. (new) A method of creating a tactile user interface on a computer system wherein a user feels force sensations when a graphically displayed cursor interacts with a particular graphical object displayed in a graphical user interface on a display device, and a location of said cursor on said display device is updated based on a received indication of movement of a physical object that is manipulated by said user, said physical object being included in a human interface device that outputs said indication to said computer system, said method comprising:

enabling the association on said computer system of a first type of graphical object with a first force sensation, said first type of graphical object associated with a first user interface function, said first force sensation represented by first sensation parameters;

enabling the associating on said computer system of a second type of graphical object with a second force sensation, said second type of graphical object associated with a second user interface function, said second force sensation represented by second sensation parameters having different values from said first sensation parameters;

determining on said computer system if said particular graphical object is of said first type or of said second type;

if said cursor has entered a region associated with said particular graphical object based on movement of said physical object, and if said particular graphical object is of said first type, enabling a sending of a signal from said computer system to said human interface device, said signal representing said first force sensation, wherein said first force sensation is output to said user using an electronically-modulated actuator of said human interface device; and

if said cursor has entered said region associated with said particular graphical object based on movement of said physical object, and if said particular graphical object is of said second type, enabling a sending of a signal from said computer system to said human interface device, said signal representing said second force sensation, wherein said second force sensation is output to said user using an electronically-modulated actuator of said human interface device.

114. (new) A method as recited in claim 113 wherein said first sensation parameters include a duration parameter that indicates the time duration for which said first force sensation should execute.

115. (new) A method as recited in claim 113 wherein a magnitude of said first force sensation is different from a magnitude of said second force sensation.

116. (new) A method as recited in claim 113 wherein said first force sensation is a vibration, wherein said parameters representing said first force sensation include magnitude, frequency, and duration parameters.

117. (new) A method as recited in claim 113 wherein said first force sensation is a texture.

118. (new) A method as recited in claim 113 wherein said first type of graphical object is an icon and said second type of graphical object is a menu item.

119. (new) A method as recited in claim 113 wherein said first type of graphical object is a menu heading and said second type of graphical object is a menu item.

120. (new) A method as recited in claim 113 wherein said first type of graphical object is a hyperlink on a web page.

121. (new) A method as recited in claim 113 wherein said signal representing said first force sensation or said signal representing said second force sensation is sent to a local microprocessor included in said interface device and separate from said computer system, said local microprocessor receiving said signal as a high level command and executing a local routine corresponding to said command to output said force sensation.

122. (new) A method of creating a tactile user interface using a computer system wherein a user feels forces when a graphically displayed cursor interacts with a particular graphical object displayed in a graphical user interface on a display device, said graphical object associated with a function of said computer system, and a location of said cursor on said display device is updated based on an indication of movement, received over a communication bus, of a physical object that is manipulated by said user, said physical object being included in a human interface device that outputs said indication to said computer system over said communication bus, said method comprising:

creating a mapping with said computer system that associates each of a plurality of types of graphical objects in said graphical user interface with at least one of a plurality of force sensations using said computer system, at least two of said assigned force sensations being different and represented by sensation parameters including a magnitude and a duration;

if said cursor has entered a boundary of a region associated with said particular graphical object, selecting with said computer system an appropriate one of said force sensations based on said mapping, said type of said particular graphical object, and a direction of motion of said cursor within said graphical user interface; and

enabling a sending of a signal from said computer system to said human interface device over said communication bus, said signal representing said selected force sensation, wherein said selected force sensation is output to said user using an electronically-modulated actuator of said human interface device.

123. (new) A method as recited in claim 122 wherein said types of graphical objects include at least one icon type, menu item type, and window type.

124. (new) A method as recited in claim 122 wherein said signal sent over said communication bus is a high level host command that includes at least one of said sensation parameters.

125. (new) A method as recited in claim 122 wherein said sensation parameters include a frequency.

126. (new) A method as recited in claim 122 wherein said magnitude of said selected force sensation is determined in part by a velocity of said cursor.

127. (new) A method as recited in claim 122 wherein said selected force sensation is a jolt sensation.

128. (new) A method as recited in claim 122 wherein said selected force sensation is a vibration sensation.

129. (new) A method as recited in claim 122 wherein said selected force sensation is a texture sensation.

130. (new) A method as recited in claim 122 wherein said signal representing said selected force sensation is sent to a local microprocessor included in said interface device and separate from said computer system, said local microprocessor receiving said signal as a high level command and executing a local routine corresponding to said high level command to output said selected force sensation.

131. (new) A method of assisting a user in manipulating a computer displayed cursor in a graphical menu displayed on a display screen of a computer system and in targeting elements in said graphical menu, the method comprising:

determining if a particular graphical element in said graphical menu with which said cursor interacts is associated with a force sensation, wherein a displayed location of said cursor is based upon signals received from said interface device that represent motion of said user manipulatable object, and wherein said interface device includes an actuator for outputting electronically modulated forces to said user; and

causing the application of a force sensation to said user by said actuator, said force sensation based on a position or movement of said user manipulatable object which causes said cursor to interact with said particular one of said elements of said menu, wherein said force sensation is a snapover force provided between elements of said menu.

132. (new) A method for providing force feedback to the user of a graphical user interface displayed by a computer system and for aiding a user in manipulating a user-controlled cursor and in targeting graphical elements in said graphical user interface, said graphical elements interfacing said user to functions of said computer system, the method comprising:

receiving data from a user interface device that represent the motion of a manipulatable physical object in at least one degree of freedom, said interface device coupled to said computer system and including an actuator for applying electronically modulated forces to be felt by said user, wherein said forces are modulated as a function of the location of said physical object in said at least one degree of freedom;

selecting a force sensation to be output to said user based at least in part on said received data, wherein a plurality of targets displayed within said graphical user interface are associated with target force sensations that are output to said user, and wherein a particular target is associated with at least two different ones of said target force sensations, said force sensations being different such that said actuator outputs forces based on parameters having different values for each of said force sensations, a first one of said different force sensations selected to be output to said user when said cursor is moved from a position outside a boundary of said particular target to a position inside said boundary, and a second one of said different force sensations selected to be output to said user when said cursor is moved from a position inside said boundary to a position outside said boundary; and

enabling the output of a signal to cause said selected force sensation to be output as forces to said user by said actuator.

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133. (new) A method of creating a tactile user interface on a computer system wherein a user feels force sensations when a graphically displayed cursor interacts with a particular graphical object displayed in a graphical user interface on a display device, and a location of said cursor on said display device is updated based on a received indication of movement of a physical object that is manipulated by said user, said physical object being included in a human interface device that outputs said indication to said computer system, said method comprising:

enabling an association on said computer system of a first type of graphical object with a first force sensation, said first type of graphical object associated with a first user interface function, said first force sensation represented by at least one first sensation parameter;

enabling an association on said computer system of a second type of graphical object with a second force sensation, said second type of graphical object associated with a second user interface function, said second force sensation represented by at least one second sensation parameter having different values from said at least one first sensation parameter;

enabling a determination on said computer system of a type of said particular graphical object, said type being one of said first type or said second type;

if said cursor is within a region associated with said particular graphical object based on movement of said physical object, and if said particular graphical object is of said first type, enabling a sending of a signal from said computer system to said human interface device, said signal representing said first force sensation, wherein said first force sensation is then output to said user using an electronically-modulated actuator of said human interface device; and

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if said cursor is within said region associated with said particular graphical object based on movement of said physical object, and if said particular graphical object is of said second type, enabling a sending of a signal from said computer system to said human interface device, said signal representing said second force sensation, wherein said second force sensation is then output to said user using an electronically-modulated actuator of said human interface device.